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Strategy behind Occidental's acquisition of Cain Chemical Page 19

DOW

UNION CARBIDE

EXXON

GRACE

Shell

Kodak

AMOCO

MAY 2, 1988

CHEMICAL & ENGINEERING

NEWS

Top 100 Chemical Producers

Page 9

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News of the Week

■ **Earnings for the first quarter climbed substantially from the year-earlier period for many companies, a C&EN survey of 20 of the largest U.S. chemical firms shows.** **Page 6**

■ **Acid rain is back in the news: atmospheric nitrate fallout has been implicated by the Environmental Defense Fund in the degradation of eastern coastal waters; the U.S. announced it wouldn't agree to a Canadian proposal for controlling nitrogen oxide emissions.** **Page 7**

■ **New class of superconducting oxides that don't contain copper and that become superconducting just below 30 K has been discovered by researchers at AT&T Bell Laboratories.** **Page 7**

■ **A number of chemists are among the 61 new members elected by the National Academy of Sciences at its recent annual meeting.** **Page 8**

■ **Wrangling within science over favorite programs must stop and relative priorities should be established, National Academy of Sciences president Frank Press told members at the academy's annual meeting.** **Page 8**

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Business

Sale of Cain Chemical to Occidental Petroleum will make Occidental the sixth largest U.S. chemical producer and will provide it with a few new product lines. **Page 19**

Bayer chairman Hermann Strenger wants Bayer USA sales to increase in the next five years to 25% of total corporate revenues. **Page 23**

Government

A mechanism for relative evaluation of major science initiatives by the scientific community should be set up, say speakers at a science policy colloquium. **Page 25**

Science

Reaction rate theories are challenged by spectroscopic studies that measure precisely the product energy state distributions of the dissociation of ketene. **Page 31**

Using organosamarium complex, UC Irvine chemists insert two carbon monoxide molecules into a carbon-carbon double bond. **Page 34**

ACS News

Official reports of the ACS Board of Directors' March meeting in Washington, D.C.; light agenda expected for council's meeting in Toronto; ACS wins public relations award. **Page 40**

News Focus

Most of the 100 largest U.S. chemical producers recorded gains in sales and operating profits in 1987, indicative of the industry's robust health. **Page 9**

Chemical & Engineering News

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LETTERS

CHEMICAL SAFETY

Sensitive sulfur nitride

SIR: It has come to our attention that a number of research groups are currently using the heterocyclic compound sulfur nitride (S_4N_4). We have worked with sulfur nitride and have performed a number of explosive sensitivity characterization tests. Results from these tests indicate sulfur nitride is an extremely sensitive, primary explosive. Sulfur nitride is more sensitive to impact and friction than is the primary explosive lead azide, commonly used in detonators.

Sensitivity to spark, however, is relatively low. The sensitivity of sulfur nitride seems to increase as a function of purity. In all these tests, decomposition was almost always extremely violent, with no explosive residue remaining. Further warnings and handling tips have been published previously [MacDairmid, A. G., "Inorganic Syntheses," Vol. 17, Robert E. Krieger Publishing Co., Melbourne, Fla., page 197 (1977)]. Thus, sulfur nitride should be considered a sensitive, primary explosive and handled with appropriate caution.

Gregory A. Buntain
Los Alamos National Laboratory

Editor's note: Additional references are: Kaye, S. M., editor, "Encyclopedia of Explosives and Related Items," Vol. 8, U.S. Army Armament Research & Development Command, Large-Caliber Weapon Systems Laboratory, Dover, N.J. (1978); and Sax, N. I., Feiner, B., "Dangerous Properties of Industrial Materials," 6th Ed., Van Nostrand Reinhold, New York, page 2491 (1984).

Plastic handguns

SIR: Alan Nixon's letter (C&EN, March 7, page 4) suggesting that ACS go on record as opposing so-called "plastic handguns" is certainly inappropriate as well as highly misleading.

First, handguns that can pass undetected through an x-ray screen simply do not exist. All firearms and cartridges contain metal. This entire plastic gun issue is merely a tactic of antigun fanatics who wish to instill their paranoia in the public in order to achieve their misguided goals. Sen. Howard Metzenbaum has been attempting to pass a plastic gun bill that effectively bans many existing small caliber weapons that are made of metal and are certainly not invisible to either metal detectors or x-ray examination. This issue is simply a misrepresentation meant to delude us into accepting further repressive legislation. The airport security problem that this bill purports to address is not one of imaginary threats but one of inadequate manpower, insufficient training, and holes in the security systems. This has been demonstrated all too often. Terrorists or the otherwise imbalanced do not need to be concerned with the detectability of their weapons because they find ways to circumvent the airport security.

Second, while I agree that it is appropriate for ACS to get involved in political issues, this should be limited to those issues that the membership as a whole has a common interest in. I do not feel that C&EN should be a medium for the discussion of every controversial topic that comes along. If this is allowed to happen this newsmagazine will become valueless as a forum of chemistry and industry interests.

John L. Krstenansky
Cincinnati

Genome mapping project

SIR: The real question on the genome mapping project (C&EN, March 14, page 22) is not James Watson's "How will it be managed?" but, rather, the question raised by David Baltimore's criticism: that the project "seems a ploy to raise money, a project justified by its public relations value, not its scientific value."

Will someone please make an adequate attempt to address this question? I mean the arguments that genome mapping is happening already (so, too, gene sequencing), that technology development is happening already, that genome databases, networking, and coordination among researchers are happening already. What, precisely, is the necessity or, anyways, the justification for this massive project?

The reporting on why a majority of the project's critics became converts has not been adequate. In all reports, including yours, we are told that the shift in focus (or at least, language) from sequencing to mapping was the key to the consensus position; the two strategies' main differences being time and money. Yet you report that as a result of this shift, instead of a "$3 billion project" requiring "thousands of hours of labor" (sequencing the entire genome), the scientists have agreed to a much more manageable "$200 million per year for about 15 years." Sorry, but I neither get it nor buy it.

Joyce Gramza
Brooklyn, N.Y.

Sales, Profits Rise for Most Top 100 Chemical Producers

Of 100 largest companies, 91 registered sales gains and 83 had higher profits in 1987, reflecting continuing health of U.S. chemical industry

William J. Storck, C&EN New York

The U.S. chemical industry enjoyed a robust year in 1987, and C&EN's compilation of financial results for the 100 largest chemical producers in the U.S. reflects this health. Sales were up for almost all the firms, and chemical operating profits improved dramatically for a majority of those that report such figures.

Nonetheless, restructuring within the industry forced some shifting in rank among the 100 from the previous year's rank, and it caused the addition or deletion of a handful of companies.

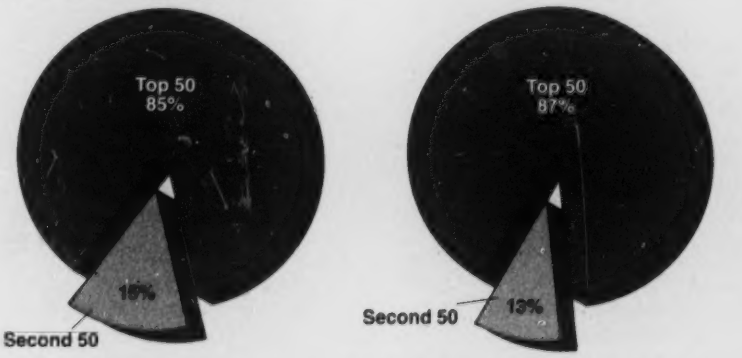
The ranking of the Top 100 chemical producers is based on chemical sales as reported in corporate annual reports and, in the case of companies not issuing annual reports, interviews with the companies.

As in the past many years, Du Pont once again has captured the top spot as the largest chemical producer in the U.S. Although it technically is a diversified company with less than half its total sales in chemicals, Du Pont amassed chemical sales totaling $13.1 billion last year, about $2.3 billion more than its nearest-ranking competitor, Dow Chemical. Indeed, that the five largest chemical producers—Du Pont, Dow Chemical, Exxon, Union Carbide, and Monsanto—all held their same ranking as the year before is a testament to their size and stability.

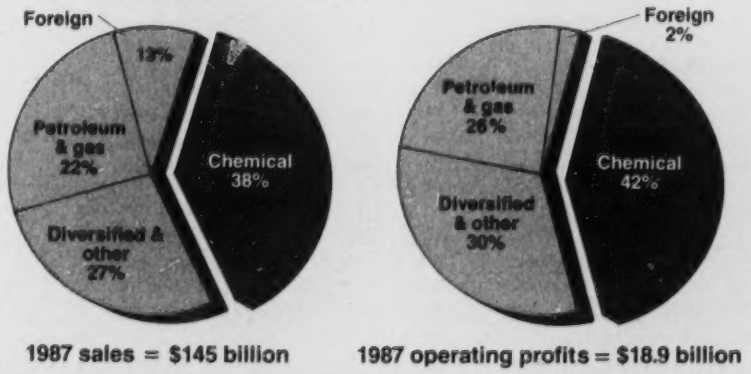
Of the 100 chemical producers, 91 posted sales gains, and only seven posted declines. For the remaining two, Avery Inc. and Cain Chemical, any comparison with 1986 is meaningless or impossible. Avery (ranked 66th), which purchased Uniroyal's chemical operations and now has put them up for sale again, had no chemical sales before the acquisition. And Cain Chemical (ranked 80th) did not exist before April 8, 1987. Cain probably would have ranked much higher had its sales been reported for a full 12-month period as for all the other companies; instead its sales are only for the period between its inception and the end of its fiscal year on Sept. 30. Considering the acquisition of Cain by Occidental Petroleum (see page 19), this year and possibly next year may mark the only appearances of Cain on the Top 100 listing.

Of the seven companies whose

Large firms have biggest share of chemical sales and earnings...



...and chemical companies sell more and earn more from chemical operations



Note: Based on sales and operating profits for Top 100 chemical producers.

Some Top 100 sales rankings changed dramatically in 1987

Rank 1987	Rank 1986		Chemical sales 1987 ($ millions)	Change from 1986	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1986	Chemical operating profits as % of total	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
1	1	Du Pont	$13,051	10.2%	42.8%	Diversified	$2314	31.2%	57.7%	17.7%	$9265	36.9%	25.0%
2	2	Dow Chemical	10,847	22.4	81.1	Basic chemicals	1930	97.3	84.2	17.8	9379	65.3	20.6
3	3	Exxon	7,177	18.1	8.7	Petroleum	1087	33.0	14.2	15.1	6285	8.5	17.3
4	4	Union Carbide	6,177[d]	23.5	89.3	Basic chemicals	872	16.6	97.4	14.1	6219	78.8	14.0
5	5	Monsanto	5,163	9.8	67.6	Basic chemicals	766	−14.5	104.4	14.8	3995	47.3	19.2
6	29	Hoechst Celanese	4,264	221.9	93.2	Basic chemicals	na	na	na	na	na	na	na
7	6	BASF	3,816	14.3	86.0	Basic chemicals	na	na	na	na	na	na	na
8	7	Shell Oil	3,578	8.7	17.2	Petroleum	600	−7.4	29.8	16.8	3681	13.7	16.3
9	8	Amoco	3,494	19.3	15.6	Petroleum	704	50.7	25.4	20.1	2689	10.8	26.2
10	16	Occidental Petroleum	2,991	43.2	16.9	Petroleum	398	126.7	51.6	13.3	2471	14.8	16.1
11	12	Mobil	2,926	22.4	5.2	Petroleum	433	111.2	10.2	14.8	2316	5.6	18.7
12	10	Allied-Signal	2,795	−0.9	25.1	Diversified	306	−11.6	40.8	10.9	2043	20.0	15.0
13	11	W. R. Grace	2,794	12.1	61.9	Specialty chemicals	357	25.3	81.5	12.8	1960	43.8	18.2
14	15	General Electric	2,751[d]	18.0	6.8	Diversified	507	19.6	11.4	18.4	3891	10.0	13.0
15	13	Eastman Kodak	2,600	9.3	19.5	Photo equipment	388	70.9	18.4	14.9	2514	17.4	15.4
16	14	Chevron	2,593	9.0	9.2	Petroleum	397	170.1	12.0	15.3	1754	5.1	22.6
17	17	Rohm & Haas	2,203	6.6	100.0	Basic chemicals	323	15.4	100.0	14.7	1587	81.2	20.4
18	18	Atlantic Richfield	1,967	3.1	11.7	Petroleum	379	166.8	31.0	19.3	2513	11.1	15.1
19	19	American Cyanamid	1,960	7.6	47.1	Basic chemicals	193	43.3	41.3	9.8	1387	33.6	13.9
20	—	Arco Chemical	1,952	26.7	100.0	Basic chemicals	398	63.1	100.0	20.4	1746	68.9	22.8
21	23	Phillips Petroleum	1,928	13.5	18.0	Petroleum	482	61.2	44.2	25.0	1165	9.6	41.4
22	20	Air Products[e]	1,919	6.8	89.2	Basic chemicals	373	2.8	116.7	19.4	2311	85.5	16.1
23	33	Quantum Chemical	1,875	72.6	73.1	Basic chemicals	348	180.5	91.5	18.5	1483	57.5	23.4
24	24	Borden	1,857	13.4	28.5	Dairy products	208	18.2	33.9	11.2	1121	27.0	18.6
25	21	Bayer USA	1,800	5.3	42.9	Basic chemicals	84[f]	0	68.3	4.7	na	na	na
26	27	B. F. Goodrich	1,741	19.4	80.3	Rubber products	210	57.3	92.1	12.1	1280	66.0	16.4
27	22	Hercules	1,686	−1.3	62.6	Basic chemicals	134	32.7	64.4	7.9	1318	37.7	10.2
28	26	Ashland Oil	1,643	11.2	22.9	Petroleum	90	26.8	33.6	5.5	603	14.9	14.9
29	25	Ciba-Geigy	1,620	8.7	57.4	Specialty chemicals	na	na	na	na	na	na	na
30	30	Texaco	1,587	24.1	4.6	Petroleum	129	41.6	1.9	8.1	1182	3.5	10.9
31	28	FMC	1,488	6.4	48.0	Machinery	242	8.0	69.6	16.3	1335	51.5	18.1
32	31	Ethyl	1,406	10.5	54.5	Basic chemicals	258	4.2	65.8	18.3	1018	51.4	25.3
33	34	Dow Corning	1,305	20.1	100.0	Specialty chemicals	135[f]	22.1	100.0	10.4	na	na	na
34	72	Rhône-Poulenc	1,300	242.1	100.0	Specialty chemicals	na	na	na	na	na	na	na
35	32	Olin	1,232	10.8	63.8	Basic chemicals	99	24.1	66.4	8.0	924	54.8	10.7
36	35	International Minerals[g]	1,214	12.7	74.1	Agrochemicals	104	197.4	58.8	8.5	1769	72.7	5.9
37	36	National Starch	1,208	13.6	100.0	Specialty chemicals	175	25.0	100.0	14.5	941	100.0	18.6
38	37	Unocal	1,071	1.4	11.4	Petroleum	27	−41.3	14.9	2.5	648	6.4	4.2
39	58	Huntsman Chemical	1,022	79.3	100.0	Basic chemicals	na	na	na	na	na	na	na
40	41	Aluminum Co. of America	982[d]	16.9	12.6	Nonferrous metals	63	284.0	9.2	6.4	2444	24.7	2.6
41	40	PPG Industries	953	13.0	18.4	Glass Products	140	35.9	18.0	14.7	1019	20.4	13.7
42	—	BP America	943	48.5	6.1	Petroleum	32	−36.5	1.4	3.4	na	na	na
43	39	Lubrizol	940	5.7	91.9	Specialty chemicals	140	−0.1	110.5	14.8	649	69.1	21.5
44	46	Aristech	919	22.4	100.0	Basic chemicals	120	23.1	100.0	13.1	na	na	na
45	74	Freeport-McMoRan	860	129.8	56.8	Agrochemicals	106	40.8	33.5	12.4	714	22.6	14.9
46	48	NL Industries	859	17.1	62.7	Petroleum services	209	23.5	140.7	24.4	734	56.3	28.5
47	42	Pennwalt	846	8.9	74.1	Basic chemicals	103	10.6	74.4	12.2	716	68.7	14.4
48	47	Nalco Chemical	842	14.4	100.0	Specialty chemicals	131	21.2	100.0	15.6	747	100.0	17.5
49	44	Reichhold Chemicals	837	9.3	100.0	Basic chemicals	na	na	na	na	na	na	na
50	44	CF Industries	810	5.7	100.0	Agrochemicals	4	def	100.0	0.5	856	100.0	0.5

Rank 1987	Rank 1986		Chemical sales 1987 ($ millions)	Change from 1986	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1986	Chemical operating profits as % of total	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
51	43	Cabot[e]	$ 800	4.1%	56.2%	Specialty metals	$ 122	−11.2%	92.3%	15.3%	$ 563	38.5%	21.7%
52	49	Eli Lilly	748	7.1	20.5	Drugs	85	60.2	8.8	11.3	724	13.8	11.7
53	53	International Flavors	746	20.2	100.0	Specialty chemicals	184	27.2	100.0	24.6	665	76.1	27.6
54	51	Morton Thiokol[g]	744	14.2	37.5	Diversified	130	48.5	50.0	17.4	698	41.9	18.6
55	62	Polysar	720	34.5	100.0	Basic chemicals	na	na	na	na	na	na	na
56	50	Engelhard	712	7.0	28.7	Specialty metals	87	13.5	83.2	12.3	677	55.6	12.9
57	56	Georgia Gulf	707	21.3	100.0	Basic chemicals	163	125.0	100.0	23.0	309	100.0	52.7
58	59	Solvay America	700[d]	27.3	100.0	Basic chemicals	na	na	na	na	na	na	na
59	52	Terra Chemicals	679	6.5	100.0	Agrochemicals	na	na	na	na	na	na	na
60	69	American Petrofina	6 0	51.9	27.0	Petroleum	203	282.3	126.6	30.3	280	15.3	72.5
61	55	Koppers	662	12.4	43.7	Diversified	31	−20.8	22.5	4.7	na	na	na
62	61	Witco	624[h]	14.6	43.7	Specialty chemicals	61	35.6	49.9	9.7	332	31.5	18.2
63	59	Vista Chemical[e]	609	10.7	100.0	Basic chemicals	119	31.2	100.0	19.6	500	100.0	23.8
64	83	Henkel	600	126.4	100.0	Specialty chemicals	na	na	na	na	na	na	na
65	63	H. B. Fuller[i]	597	13.0	100.0	Specialty chemicals	48	20.9	100.0	8.0	330	100.0	14.5
66	—	Avery[e]	591	nm	98.4	Agrochemicals	na	na	na	na	na	na	na
67	57	Farmland Industries	525	−8.6	20.1	Agricultural supplies	1	def	1.7	0.2	316	40.1	0.4
68	70	Pfizer	514	23.6	10.4	Drugs	70	71.4	6.6	13.6	483	7.0	14.4
69	64	Liquid Air	505	2.8	69.8	Basic chemicals	68	15.7	96.9	13.6	610	81.2	11.2
70	68	CBI Industries	492	9.1	42.4	Construction	68	12.5	82.3	13.7	612	48.3	11.1
71	80	Great Lakes Chemical	478	59.3	100.0	Specialty chemicals	85	99.1	100.0	17.8	577	100.0	14.7
72	66	Henley Manufacturing	464	1.9	76.7	Basic chemicals	39	25.0	101.9	8.5	372	54.2	10.6
72	66	Kerr-McGee	464	1.8	17.8	Petroleum	71	9.2	13.7	15.3	549	19.0	12.9
74	71	Tyler	436	12.4	39.6	Diversified chemicals	37	35.3	55.5	8.4	203	37.4	18.0
75	73	GAF	431	14.3	51.5	Specialty chemicals	130	20.6	82.5	30.1	420	32.3	31.0
76	75	Merck	431	20.1	8.5	Drugs	58	15.4	4.2	13.4	429	7.6	13.4
77	76	Betz Laboratories	386	12.0	100.0	Specialty chemicals	68	6.8	100.0	17.5	287	100.0	23.6
78	77	Sun Co.	371	17.0	3.9	Petroleum	na	na	na	na	na	na	na
79	81	Ferro	362[d]	26.9	41.6	Specialty materials	28	25.7	39.0	7.7	187	35.1	14.9
80	—	Cain Chemical[j]	357	nm	100.0	Basic chemicals	na	na	na	na	na	na	na
81	79	Union Camp	348	14.3	15.1	Diversified	21	236.9	5.6	6.0	279	9.6	7.5
82	82	Loctite	338	26.6	100.0	Specialty chemicals	45	23.3	100.0	13.4	297	97.8	15.3
83	78	Chemed	336	6.9	85.9	Specialty chemicals	41	25.4	84.5	12.3	177	67.1	23.3
84	88	Lonza	312	23.8	100.0	Specialty chemicals	na	na	na	na	na	na	na
85	85	Vulcan Materials	298	17.4	32.2	Nonmetallic minerals	33	68.6	17.9	11.0	na	na	na
86	84	Stepan	289	11.2	100.0	Specialty chemicals	119	751.6	620.0	41.3	173	100.0	69.0
87	89	Dexter	285	16.5	36.4	Rubber products	29	25.4	30.3	10.3	182	61.9	16.1
88	85	Petrolite[k]	248	−2.2	89.1	Specialty chemicals	21	−6.2	99.2	8.6	181	73.0	11.8
89	91	Sigma-Aldrich	247	24.1	81.2	Specialty chemicals	64	21.1	88.2	25.8	246	86.1	25.9
90	85	KaiserTech	239	−5.9	10.8	Nonferrous metals	16	−51.8	def	6.8	na	na	na
91	92	Essex Chemical	191	3.8	91.4	Basic chemicals	28	−13.3	172.9	14.5	143	64.2	19.3
92	93	Crompton & Knowles	191	15.8	80.3	Specialty chemicals	20	33.1	70.7	10.4	98	72.3	20.2
93	94	Georgia-Pacific	189	21.9	3.3	Wood products	na	na	na	na	na	na	na
94	95	First Mississippi	181	18.5	61.2	Agrochemicals	8	−59.6	80.9	4.4	81	27.4	9.9
95	90	Mississippi Chemical[g]	174	−23.5	101.8	Farm cooperative	−26	def	def	def	230	100.0	def
96	97	Quaker Chemical	148	15.2	100.0	Specialty chemicals	17	21.6	100.0	11.4	118	100.0	14.2
97	96	Agway	133	−6.4	4.1	Farm cooperative	na	na	na	na	na	na	na
98	99	LeaRonal[l]	126	21.6	100.0	Specialty chemicals	13	21.2	100.0	9.8	75	96.3	16.8
99	98	UGI	116	2.9	27.6	Natural gas	1	def	2.5	1.3	61	10.2	2.4
100	100	Lawter Chemicals	112	8.2	100.0	Specialty chemicals	25	24.6	100.0	21.9	110	100.0	22.3

a Operating profit is sales less administrative expenses and cost of sales. b Operating profit from chemicals as a percentage of chemical sales. c Chemical operating profit as a percentage of identifiable chemical assets. d Chemical sales include significant amounts of nonchemical products. e Fiscal year ends Sept. 30. f Chemical net income. g Fiscal year ends June 30. h Does not include all chemical sales. i Fiscal year ends Nov. 30. j Sales are only for the period between formation of the company April 8, 1987, and end of fiscal year Sept. 30. k Fiscal year ends Oct. 31. l For fiscal year ended Feb. 28, 1987. na = not available. nm = not meaningful. def = deficit.

C&EN's five-way ranking of the Top 100 chemical producers

	Chemical sales			Chemical operating profits			Chemical operating profit margin			Identifiable chemical assets			Return on chemical assets		
		Rank			Rank			Rank			Rank			Rank	
$ Millions	1987	1987	1986	1987	1987	1986	1987	1987	1986	1987	1987	1986	1987	1987	1986
Agway	$ 133	97	98	na	—	—	na	—	—	na	—	—	na	—	—
Air Products	1,919	22	20	$ 373	16	9	19.4%	13	5	$2311	14	13	16.1%	38	27
Allied-Signal	2,795	12	10	306	20	10	10.9	56	37	2043	15	14	15.0	44	30
Aluminum Co. of America	982	40	41	63	58	76	6.4	73	82	2444	12	11	2.6	72	76
American Cyanamid	1,960	19	19	193	27	29	9.8	60	65	1387	22	25	13.9	54	56
American Petrofina	670	60	69	203	26	52	30.3	2	39	280	61	64	72.5	1	16
Amoco	3,494	9	8	704	6	7	20.1	11	18	2689	8	9	26.2	8	25
Arco Chemical	1,952	20	—	398	11	na	20.4	10	—	1746	29	24	22.8	15	—
Aristech	919	44	46	120	40	37	13.1	45	34	na	—	—	na	—	—
Ashland Oil	1,643	28	26	90	47	47	5.5	75	77	603	46	47	14.9	45	44
Atlantic Richfield	1,967	18	18	379	15	25	19.3	14	65	2513	10	18	15.1	43	61
Avery	591	66	—	na	—	—	na	—	—	na	—	—	na	—	—
BASF	3,816	7	6	na	—	—	na	—	—	na	—	—	na	—	—
BP America	943	42	—	32	67	na	3.4	79	—	na	—	—	na	—	—
Bayer USA	1,800	25	21	84	51	42	4.7	76	76	na	—	—	na	—	—
Betz Laboratories	386	77	76	68	54	49	17.5	21	11	287	60	60	23.6	12	14
Borden	1,857	24	24	208	25	19	11.2	54	47	1121	28	21	18.6	26	46
CBI Industries	492	70	68	68	54	50	13.7	39	31	612	44	44	11.1	63	55
CF Industries	810	50	44	4	81	86	0.5	82	—	856	33	30	0.5	74	—
Cabot	800	51	43	122	39	28	15.3	26	13	563	48	48	21.7	18	8
Cain Chemical	357	80	—	na	—	—	na	—	—	na	—	—	na	—	—
Chemed	336	83	78	41	63	66	12.3	48	48	177	69	71	23.3	14	18
Chevron	2,593	16	14	397	13	23	15.3	26	73	1754	18	8	22.6	16	72
Ciba-Geigy	1,620	29	25	na	—	—	na	—	—	na	—	—	na	—	—
Crompton & Knowles	191	91	93	20	76	77	10.4	57	55	98	74	78	20.2	22	31
Dexter	285	87	89	29	69	70	10.3	59	53	182	67	71	16.1	38	38
Dow Chemical	10,847	2	2	1930	2	2	17.8	18	45	9379	1	2	20.6	20	47
Dow Corning	1,303	33	34	135	33	32	10.4	57	49	na	—	—	na	—	—
Du Pont	13,051	1	1	2314	1	1	17.7	20	21	9265	2	1	25.0	11	19
Eastman Kodak	2,600	15	13	388	14	16	14.9	30	52	2514	9	12	15.4	41	57
Eli Lilly	748	52	49	85	49	52	11.3	53	63	724	36	33	11.7	61	69
Engelhard	712	56	50	87	48	44	12.3	48	42	677	40	37	12.9	58	45
Essex Chemical	191	91	92	28	70	67	14.5	36	15	143	71	76	19.3	23	3
Ethyl	1,406	32	31	258	21	15	18.3	17	8	1018	30	32	25.3	10	5
Exxon	7,177	3	3	1087	3	4	15.1	29	29	6285	3	3	17.3	34	35
FMC	1,488	31	28	242	22	17	16.3	24	17	1335	23	23	18.1	31	27
Farmland Industries	525	67	57	1	82	85	0.2	83	—	316	57	55	0.4	75	—
Ferro	362	79	81	28	70	72	7.7	71	61	187	66	71	14.9	45	42
First Mississippi	181	94	95	8	80	73	4.4	78	34	81	75	80	9.9	68	6
Freeport-McMoRan	860	45	74	106	43	45	12.4	47	5	714	38	65	14.9	45	2
H. B. Fuller	597	65	63	48	61	62	8.0	68	64	330	56	57	14.5	49	43
GAF	431	75	73	130	36	33	30.1	3	1	420	53	63	31.0	5	1
General Electric	2,751	14	15	507	8	8	18.4	16	12	3891	6	6	13.0	57	50
Georgia Gulf	707	57	56	163	30	46	23.0	8	36	309	58	61	52.7	3	9
Georgia-Pacific	189	93	94	na	—	—	na	—	—	na	—	—	na	—	—
B. F. Goodrich	1,741	26	27	210	23	30	12.1	51	54	1280	25	26	16.4	36	54
W. R. Grace	2,794	13	11	357	17	12	12.8	46	43	1960	16	17	18.2	29	26
Great Lakes Chemical	478	71	80	85	49	59	17.8	18	25	577	47	na	14.7	48	—
Henkel	600	64	83	na	—	—	na	—	—	na	—	—	na	—	—
Henley Manufacturing	464	72	66	39	64	67	8.5	64	71	372	54	53	10.6	66	65

$ Millions	Chemical sales	Rank		Chemical operating profits	Rank		Chemical operating profit margin	Rank		Identifiable chemical assets	Rank		Return on chemical assets	Rank	
	1987	1987	1986	1987	1987	1986	1987	1987	1986	1987	1987	1986	1987	1987	1986
Hercules	$1,666	27	22	$ 134	34	36	7.9%	70	74	$1318	24	20	10.2%	67	68
Hoechst Celanese	4,264	6	29	na	—	—	na	—	—	na	—	—	na	—	—
Huntsman Chemical	1,022	39	58	na	—	—	na	—	—	na	—	—	na	—	—
International Flavors	746	53	53	184	28	24	24.6	6	3	665	41	46	27.6	7	11
International Minerals	1,214	36	35	104	44	64	8.5	64	79	1769	17	16	5.9	70	75
KaiserTech	239	90	85	16	78	65	6.8	72	31	na	—	58	na	—	48
Kerr-McGee	464	72	66	71	52	48	15.3	26	24	549	49	45	12.9	58	48
Koppers	662	61	55	31	68	61	4.7	76	72	na	—	55	na	—	51
Lawter Chemicals	112	100	100	25	73	73	21.9	9	10	110	73	79	22.3	17	17
LeaRonal	128	98	99	13	79	81	9.8	60	50	75	76	81	16.8	35	31
Liquid Air	505	69	64	68	54	51	13.6	40	39	610	45	38	11.2	62	58
Loctite	336	82	82	45	62	63	13.4	42	27	297	59	65	15.3	42	33
Lonza	312	84	88	na	—	—	na	—	—	na	—	—	na	—	—
Lubrizol	940	43	39	140	31	26	14.8	31	19	649	42	39	21.5	19	13
Merck	431	75	75	58	60	56	13.4	42	26	429	52	52	13.4	56	51
Mississippi Chemical	174	95	90	−26	84	84	def	—	—	230	64	61	def	—	—
Mobil	2,826	11	12	433	10	18	14.8	31	58	2316	13	15	18.7	25	59
Monsanto	5,163	5	5	766	5	3	14.8	31	9	3995	5	5	19.2	24	15
Morton Thiokol	744	54	51	130	36	41	17.4	22	29	698	39	41	18.6	26	33
NL Industries	859	46	48	209	24	21	24.4	7	4	734	35	43	28.5	6	3
Nalco Chemical	842	48	47	131	35	33	15.6	25	23	747	34	40	17.5	33	24
National Starch	1,208	37	36	175	29	26	14.5	36	33	941	31	34	18.6	26	21
Occidental Petroleum	2,991	10	16	398	11	19	13.3	44	59	2471	11	10	16.1	38	66
Olin	1,232	35	32	99	46	43	8.0	68	67	924	32	31	10.7	65	60
PPG Industries	953	41	40	140	31	35	14.7	34	36	1019	29	27	13.7	55	66
Pennwalt	846	47	42	103	45	38	12.2	50	39	716	37	36	14.4	50	40
Petrolite	248	88	85	21	74	70	8.6	63	55	181	68	74	11.8	60	38
Pfizer	514	68	70	70	53	60	13.6	40	50	483	51	51	14.4	50	62
Phillips Petroleum	1,928	21	23	482	9	11	25.0	5	14	1165	27	29	41.4	4	7
Polysar	720	55	62	na	—	—	na	—	—	na	—	—	na	—	—
Quaker Chemical	148	96	97	17	77	78	11.4	52	46	118	72	77	14.2	52	41
Quantum Chemical	1,875	23	33	348	18	31	18.5	15	43	1483	21	22	23.4	13	64
Reichhold Chemicals	637	49	44	na	—	52	na	—	69	na	—	50	na	—	51
Rhône-Poulenc	1,300	34	72	na	—	—	na	—	—	na	—	—	na	—	—
Rohm & Haas	2,203	17	17	323	19	13	14.7	34	26	1587	20	19	20.4	21	20
Shell Oil	3,578	8	7	600	7	6	16.8	23	7	3681	7	7	16.3	37	22
Sigma-Aldrich	247	89	91	64	57	52	25.8	4	2	246	63	68	25.9	9	12
Solvay America	700	58	59	na	—	—	na	—	—	na	—	—	na	—	—
Stepan	289	86	84	119	41	76	41.3	1	75	173	70	75	68.0	2	62
Sun Co.	371	78	77	na	—	—	na	—	—	na	—	—	na	—	—
Terra Chemicals	679	59	62	na	—	—	na	—	—	na	—	—	na	—	—
Texaco	1,587	30	30	129	38	39	8.1	67	68	1182	26	28	10.9	64	67
Tyler	436	74	71	37	65	69	8.4	66	69	203	65	69	18.0	32	37
UGI	116	99	98	1	82	83	1.3	81	—	61	77	70	2.4	73	—
Union Camp	348	81	79	21	74	82	6.0	74	81	279	62	67	7.5	69	74
Union Carbide	6,177	4	4	872	4	5	14.1	38	20	6219	4	4	14.0	53	35
Unocal	1,071	36	37	27	72	57	2.5	80	76	648	43	35	4.2	71	71
Vista Chemical	609	63	59	119	41	39	19.6	12	16	500	50	49	na	—	23
Vulcan Materials	298	85	85	33	66	75	11.0	55	62	na	—	—	na	—	—
Witco	624	62	61	61	59	58	9.7	62	60	332	55	59	18.2	29	29

Note: Companies with negative profitability are not ranked. na = not available. def = deficit.

sales declined, three are in the troubled fertilizer industry—Agway, Mississippi Chemical, and Farmland Industries. The other four are Allied-Signal, Hercules, Petrolite, and KaiserTech.

Eighty-four companies in the group reported information on chemical operating profits, and only one of them, Mississippi Chemical, showed a loss for the year. However, 12 posted declines in earnings from the previous year.

The larger firms continue to dominate the Top 100, as do companies whose primary business is chemicals. In 1987, the 50 largest chemical producers accounted for 85% of the total sales of the 100 companies and 87% of the operating profits. This is a slight decline from the year before, when the largest 50 companies accounted for 86% of total sales and 90% of operating profits.

Companies whose largest business is chemicals also continue to account for more of the financial results than do other categories. In 1987, chemical companies contributed 38% of the total sales of the 100 companies and 42% of total operating profits. These percentages were the same as in last year's listing.

Petroleum and natural gas-producing firms made up 22% of sales and 26% of operating profits. Here sales were down from 25% in 1986, but the share of earnings was up from 24%. Diversified companies contributed 27% of sales last year, down slightly from 28% in 1986, and their earnings contribution fell to 30% from 32% the year before.

Foreign-owned chemical producers, most of which could be counted as chemical companies, contributed 13% of total sales in 1987, compared with just 9% in 1986. Earnings contributions from the overseas-owned companies were 2% in both years. The very low earnings contributions by the foreign-owned firms stem not from poor results, but rather from the fact that so few of them report chemical profits. Undoubtedly, if the same percentage of these companies reported their profits as did their counterparts in other categories, their contribution to earnings would fall more in line with their sales contribution.

In 1987, as in past years, industry restructuring played a large role in shaping the rankings. Besides Avery and Cain, there were two other companies new to the listing this year. Arco Chemical ranked 20th after it was formed by a spinoff of some of Atlantic Richfield's chemical operations. Atlantic Richfield remains on the list because of its retained chemical businesses. The other new company is BP America, in the 42nd spot. BP, although it long has had chemical operations in the U.S., had not reported its results until acquiring Standard Oil. As a result, Standard Oil has been dropped from the list.

Other companies no longer ranked include Borg Warner, which has "gone private" and no longer discloses chemical results; Williams Cos., which sold its Agrico fertilizer operations to Freeport McMoRan Partners; and Celanese, which was acquired by Hoechst.

The acquisition of Celanese by Hoechst caused one of the largest jumps in the rankings for 1987. The combined company—Hoechst Celanese—gained the ranking of 6th, up from 29th in 1986 when the firm was known as American Hoechst. However, Celanese was 10th in the 1986 ranking.

Although the Hoechst Celanese combination was the largest dollar move among the Top 100, its ranking jump of 23 places was not the greatest. That distinction goes to Rhône-Poulenc, which climbed 38 spots to end up as 34th, compared with its rank of 72nd in 1986. The French-owned company gained its position on the strength of purchasing Union Carbide's agricultural chemicals business and the Stauffer basic chemical business from ICI.

Also upgrading its rank more than Hoechst Celanese was Freeport-McMoRan, which jumped 29 places to 45th after placing only 74th in the 1986 ranking. Two other companies improved their rankings by 19 places. Huntsman Chemical moved to the 39th spot in 1987 from 58th in 1986. And Henkel climbed to 64th from 83rd the year before.

All in all, of the 100 companies, 30 improved in rank in 1987 from the year before, 51 declined in rank, and 15 held the same position. Four companies were new to the list.

As in past years, companies in the 1987 list are compared with what their rankings actually were one year ago, rather than what they would have been had the previous year's results been restated for divestitures, acquisitions, or other corporate developments. Thus, a rise or fall in rank will reflect these developments as well as any normal increase or decrease from operations.

Other factors can influence the rankings. For instance, in the case of some foreign companies, currency translations from year to year can change results from what the company actually states. This may be why, for C&EN's calculations, Lonza shows a 24% increase in sales, whereas the U.S. arm of the Swiss-owned company claims only a 13% increase in sales for the year. Again, where possible, C&EN tries to calculate changes in results from the previous year's figures rather than from figures that may have been restated in the current year.

Admittedly, the C&EN ranking does not include all U.S. chemical operations that could be on it. In many cases, for one reason or another, companies will not disclose their chemical sales. For instance, Borg Warner still has its chemical operations, dominated by acrylonitrile-butadiene-styrene, but since it is now in private hands it does not disclose its chemical sales. Others that would surely make the list include 3M and such foreign-owned firms as Britain's ICI Americas and West Germany's Sherex.

Besides chemical sales, C&EN also ranks the companies according to chemical operating profits, chemical operating profit margins, identifiable chemical assets, and return on chemical assets (chemical operating profits as a percentage of identifiable chemical assets). As in sales, Du Pont ranked number one in chemical operating profits in 1987 with a total of $2.31 billion. However, Dow Chemical beat out Du Pont in chemical assets with a total of $9.38 billion. In terms of profitability, Stepan ranked number one in operating profit margin at 41%. And American Petrofina had the best return on chemical assets at a whopping 73%. □

Priority-Setting Urged in Funding of Major Science Initiatives

In light of federal budget constraints, mechanism is needed for reaching consensus in scientific community on which large projects to fund

Janice R. Long, C&EN Washington

Policy makers for years have been urging the scientific community to become involved in setting priorities for federal research funding. That kind of input is needed now more than ever as new "big science" initiatives and traditional "little science" projects chase hard-to-find federal research dollars, according to speakers at the American Association for the Advancement of Science's Thirteenth Annual Colloquium on R&D Policy held late last month in Washington, D.C.

President Reagan's fiscal 1989 budget request (C&EN, Feb. 29, page 7) seeks an average 14.5% increase over fiscal 1988 for nondefense R&D programs, though only a 2.2% increase for defense R&D. And as Rep. Doug Walgren (D.-Pa.), chairman of the House Subcommittee on Science, Research & Technology, pointed out, "The R&D budget as proposed would commit the government to a number of new, expensive, highly visible science projects." These include the space station, the Superconducting Super Collider (SSC), the national space plane, a project to map the human genome, and a 19% increase in the National Science Foundation's budget.

"Frankly," Walgren said, "I don't know where we will find the money to carry these programs through to completion. Simply putting them in the budget without setting priorities . . . is a questionable victory."

As he sees it, "big science" projects need to meet a very high burden of proof on what a particular project will deliver to society in terms of economic benefits or contributions to the national defense. He explained that one has to approach such projects with a great deal of caution because of their impact on science and technology funding as a whole.

He pointed out that funding the SSC would not only diminish ongoing programs in the Department of Energy's high-energy physics program, but programs in many other areas of science as well. For example, to reserve millions of dollars for the SSC, the Administration's 1989 budget cuts funding for R&D on fossil fuels in half.

Walgren believes that "the individual investigator is the pillar on which scientific advances rest, and there is no quicker way to chill scientific advances than not to have money to fund new researchers."

C&EN staff photo

Walgren: competing priorities

Bloch: hard choices must be made

Yet, as he also pointed out, the benefits of undirected basic research are hard to quantify. The question, he said, "is where does basic research fit into the equation of competing priorities?" Walgren warned attendees at the colloquium not to look to Congress for a great deal of wisdom in setting research priorities and urged individual scientists and scientific groups to get involved in the priority-setting process.

Robert M. Rosenzweig, president of the Association of American Universities, touched on the same themes at the colloquium. He said that he "sees no realistic set of circumstances in which science will receive from the federal government all that it wants, needs, or deserves." This is true even though, as he pointed out, "in almost every respect the case for doing more is overwhelming. The opportunities for new knowledge have never been greater, nor has the need. And the people to supply it are in place and ready to go."

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But, according to Rosenzweig, the reality for science is "that there is more to do than the country is willing, some would say able, to pay for right now. Someone will need to make the painful decisions." There is no question, he said, that the decisions will be political and will be made through political processes. The question is whether those decisions will be made well or badly. The difference between good and bad decisions frequently turns on the balance between narrow constituency interest and a conception of some broader set of interests.

It's that latter conception that Rosenzweig feels is lacking in the scientific community. He believes that neither scientists themselves nor those responsible for the institutions in which most science is conducted are "now prepared to participate constructively" in a priority-setting process. He pointed out "that there is no lack of passionate advocacy for every item on the agenda; there is a virtually total absence of help for any serious-minded government official who wants to think about how to think about the decisions that must be made."

He suggested that in their various forums scientists discuss, "as appropriate to each group, such questions as ... where the logic of science itself leads most compellingly; how to evaluate return on investment in the fullest meaningful terms; [if] the capacity of the system, its structures, and its people ... [can] sustain the level of effort that the current agenda calls for; and what decision-making processes are likely to produce the best investment choices."

Rosenzweig noted that "choices that are made without regard for the opportunities that will be foregone are not serious choices. We are drifting in the direction of just such easy, unserious thinking in our own counsels, thereby encouraging uninformed and dangerous decisions by government. We need to do better."

Just how painful the priority-setting process can be in the face of Congressional choices is exemplified by the recent experiences of

Direct federal support for chemical research is up 6%...

$ Millions	1989[a]	1988[b]	1987[c]	% change 1988–89
NSF	$160.0	$148.8	$147.2	8%
Energy[d]	138.0	131.1	116.5	5
Defense	38.3	34.7	40.4	10
NBS	12.2	10.1	9.7	21
TOTAL	$348.5	$324.7	$313.8	7%

...programs that support some chemistry are up 6%...

$ Millions	1989[a]	1988[b]	1987[c]	% change 1988–89
NIH[e]	$575.3	$533.1	$498.1	8%
EPA	259.8	244.9	247.0	6
Energy	82.8	99.8	101.7	−17
NSF	82.8	72.6	73.5	14
NBS	71.0	61.1	53.9	16
TOTAL	$1071.7	$1011.5	$974.2	6%

...and support for chemical engineering is up 36%

$ Millions	1989[a]	1988[b]	1987[c]	% change 1988–89
Energy	$1078.0	$775.2	$646.3	39%
EPA	59.5	53.2	52.2	12
NSF	37.1	33.4	33.0	11
TOTAL	$1174.6	$861.8	$731.5	36%

a Administration's request. b Estimate. c Actual. d Support for extramural "6.1" basic research. e Excludes funding for biochemical research. **Sources:** American Chemical Society, American Institute of Chemical Engineers

NSF Director Erich Bloch. As he told attendees, NSF started the 1988 budget cycle with high hopes. The Administration had proposed a 20% increase for NSF—the first installment in a plan to double the foundation's budget over five years. But it ended up very disappointed. Congress, which had been very supportive of the budget-doubling idea, ended up providing only a 3% increase for NSF's research activities and left it for the fourth year in a row with an essentially flat budget.

Still, Bloch said, even within those budget constraints every research division got an increase. For example, materials research got a 2% increase. But, he pointed out, "Mortgages carried forward from 1987 came home to roost." NSF could have funded all of the two- or more-year materials research grants. However, absolutely no new researchers could have been supported. Thus, NSF made the decision to cut back on existing materials research grants by 6 to 12% to support new research. "We're not proud of that, but it was the best we could do in a bad situation," Bloch explained.

The tight budget forced NSF to make a number of other tough decisions. The growth in undergraduate research support was slowed. Funding for current facilities, such as the supercomputer centers, was stretched out and no new ones are being funded. There was no increase in either grant size or numbers. And funding for the new science and technology centers program was deferred, because, as Bloch explained, there was "just no room in the budget to even make a start" on the program.

"The lesson of 1988," Bloch said, "is priorities." And he warned that many more such hard choices must be made even if NSF's fiscal 1989 request for a 19% budget increase is successful. He doesn't think it will be. Even though there are "good" budget resolutions in both the House and Senate (C&EN, April 25, page 5), Bloch noted that neither would support all of the increases in research funding that the Administration requested. Noting that "Congress knows that there are other needs than science," Bloch predicted that "the best we can expect is one half to three quarters" of what was requested.

Noting that NSF had made specific choices within its own budget, even though it would have been easier to make across-the-board budget cuts because "then nobody could have complained," Bloch urged the scientific community to do the same thing. He admitted that it would be difficult for the highly pluralistic scientific community to speak with one voice, but suggested that the national academies or NSF advisory committees might serve as forums to debate the issues and build a consensus on priorities. However, he warned that if the scientific community doesn't learn to speak coherently, it won't be effective in getting all or even most of the support it believes it needs. □

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